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"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड़ नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 10572 (1983): Method of sampling pumps [MED 20: Pumps]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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Indian Standard

METHODS OF SAMPLING FOR PUMPS

1. Scope — This standard prescribes process control requirements to ensure a uniform product quality and the methods of sampling and the criteria for conformity for acceptance of the lot offered for inspection.

2. Terminology

2.1 For the purpose of the standard, the definitions given in IS : 2500 (Part II)-1965 'Sampling inspection tables : Part II Inspection by variables for percent defectives' shall be applicable in addition to those given below.

2.2 *Lot* — The number of pumps of the same size, type and duty point offered for inspection at one time shall constitute a lot.

2.3 *Sampling* — The selection of a portion of a lot with a view to taking a decision about the quality of the lot on the basis of results obtained by inspecting the selected portion.

2.4 *Sample Size* — The number of pumps selected for inspection and/or testing from a lot.

2.5 *Mean* ($\bar{x}$) — The sum of the observations divided by the number of observations.

2.6 *Range* (*R*) — The difference between the largest and the smallest observations or test results in a sample.

> **Note** — In case the number of results in the sample is ten or more, they shall be divided into sub-groups of five test results each taking them consecutively in the same order as obtained. The range of each sub-group shall then be determined with a view to obtaining the mean range.

2.7 *Mean Range* — The mean of a set of ranges calculated for sub-groups in the sample.

3. Process Control

3.1 The object of inspection and testing of pumps by the purchaser is to ensure their conformity to the requirements of the specification agreed upon, whereas the inspection and testing carried out by the manufacturer during production is to ensure the conformity to the specification as well as to maintain a satisfactory control over the process. Quality control during production can build quality and reliability into the pumps whereas inspection done at a later stage can only help decision regarding the acceptability of quality of pumps. Hence, it is highly desirable that the manufacturer should have his own scheme of sampling and testing during process so that the quality fluctuations during production can be monitored and timely action may be taken in correcting any abnormal situation.

3.2 *Casting* — In the manufacture of grey and malleable iron casting, regular testing of raw material batch-wise as also testing of sand for various characteristics is of paramount importance. Process parameters during casting as well as heat treatment also highly influence the quality of iron castings. The degree of control is left to the manufacturer depending on the manufacturing process.

4. Scale of Sampling for Lot Inspection

4.1 Pumps shall be selected and examined for each lot separately for ascertaining the conformity to the requirements of the relevant specification.

4.2 The number of pumps to be selected from a lot shall depend upon the size of the lot and in accordance with Table 1.

4.3 The required number of pumps for testing shall be chosen at random from the lot. To ensure the randomness of selection, IS : 4905-1968 'Methods for random sampling' shall be used.

4.4 The pumps thus selected shall be subjected to relevant tests for determining various characteristics.

Pumps Sectional Committee, EDC 35; Horizontal Spindle Pumps Subcommittee, EDC 35 : 2 [Ref: Doc : EDC 35 (3788)]

TABLE 1 SIZE OF SAMPLING FOR PUMPS

(*Clause* 4.2)

Lot Size	Sample Size
(1)	(2)
Up to 25	3
26 to 50	4
51 to 100	5
101 to 150	7
151 to 300	10
301 and above	15

5. Criteria for Conformity

5.1 For ascertaining the conformity of the lot the procedure given in 5.1.1 and 5.1.2 shall be adopted. The calculations required for the procedure are as follows:

Let $x_1, x_2, x_3 \ldots\ldots\ldots\ldots x_n$ be the results of 'n' pumps tested as per 4.4 for a particular characteristic.

Calculate

$$\text{Average } (\bar{x}) = \frac{x_1 + x_2 + x_3 + \ldots\ldots\ldots\ldots x_n}{n}$$

and Range (R) = The difference between the maximum and the minimum value

or $\bar{R}$ = the mean of a set of ranges calculated for sub-group of five observations in the sample

When the sample size is 10, $\bar{R} = \dfrac{R_1 + R_2}{2}$

When the sample size is 15, $\bar{R} = \dfrac{R_1 + R_2 + R_3}{3}$

Where R_1, R_2 and R_3 are ranges of sub-groups of five observations.

5.1.1 *For one-sided specification limit* — The lot shall be declared as conforming to the specification if:

a) The value of the expression $(\bar{x} + 0\cdot5R)$ or $(\bar{x} + 0\cdot5\bar{R})$ is less than or equal to U, when the upper specification limit U is given; and

b) The value of the expression $(\bar{x} - 0\cdot5R)$ or $(\bar{x} + 0\cdot5\bar{R})$ is greater than or equal to L, when the lower specification limit L is given.

5.1.2 *For two-sided specification limit* — The lot shall be declared as conforming to specification if:

a) The value of the expression $(R/U - L)$ or $(R/U - L) \leq 0\cdot9$,

b) The value of the expression $(\bar{x} + 0\cdot5R)$ or $(\bar{x} + 0\cdot5\bar{R}) \leq U$, and

c) The value of the expression $(\bar{x} - 0\cdot5R)$ or $(\bar{x} - 0\cdot5\bar{R}) \geq L$.

6. Illustrations

6.1 *When One Sided Specification Limit is Given* — A consignment of 75 pumps meeting the tolerance limit on efficiency as given in 9.4.2 of IS : 9137-1979 'Code for acceptance tests for centrifugal, mixed flow and axial pumps — Class C' was delivered to a buyer. The buyer desires to ascertain the conformity of the lot to this requirements. The guaranteed value as declared by the manufacturer is 59 percent. The Indian Standard IS : 9137-1979 specifies that the efficiency shall be at least 95 percent of that specified, that is, 56 percent.

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IS:10572-1983   METHODS OF SAMPLING FOR PUMPS

[*Page 2, clauses 5.1.1*(b) *and* 5.1.2(a)] -
Substitute the following for the existing
sentences:

'5.1.1   b) The value of expression ($\bar{X}$ - 0.5R),
or ($\bar{X}$ - 0.5$\bar{R}$) is greater than or
equal to L, when the lower speci-
fication limit L is given.

5.1.2   a) The value of the expression
($R/U-L$) or ($\bar{R}/U-L$) $\leqslant$ 0.9.'

(EDC 35)

The number of pumps to be chosen from the lot as per 4.2 is 5. In order to select 5 pumps at random from the lot, IS : 4905-1968 is referred to. The following numbers have been drawn with the help of IS : 4905-1968:

$$72, 21, 1, 50 \text{ and } 13$$

Starting from any pump, the pumps in the lot are counted in one order and the pumps corresponding to the above numbers are selected for testing.

The following values of the pump efficiency (expressed as percentage) are observed:

$$59.5, 60.5, 61.0, 58.5, 57.0$$

Then the mean $\bar{x}$ of the test results are calculated as

$$\bar{x} = \frac{59.5 + 60.5 + 61.0 + 58.5 + 57.0}{5}$$

$$= 59.30$$

and the range R is $= 61.0 - 57.0$

$$= 4.0$$

$$\bar{x} - 0.5R = 59.3 - 0.5 \times 4 = 57.3 > 56.0$$

Since the criterion given in 5.1.1 is satisfied, it is concluded that the lot conforms to the specification requirement of pump efficiency.

6.2 *When Two-Sided Specification Limit is Given* — The guaranteed value of the power input is 2.2 kW. For mass produced pumps, IS : 9137-1979 specifies a tolerance of ± 8 percent of the guaranteed value for the power input. Hence, the upper (U) and lower (L) specification limits are 2.4 and 2.0 kW respectively.

The above set of pumps give the following power input values:

2.06, 2.12, 2.08, 2.18 and 2.15. The mean ($\bar{x}$) of the test results are calculated as:

$$\bar{x} = \frac{2.06 + 2.12 + 2.08 + 2.18 + 2.15}{5}$$

$$= 2.12$$

and the Range (R) $= 2.18 - 2.06$

$$= 0.12$$

Now,

a) $\dfrac{R}{U-L} = \dfrac{0.12}{0.36} = 0.33 < 0.9$

b) $\bar{x} + 0.5R = 2.12 + 0.5 \times 0.12$
$= 2.18 < 2.4$ (U)

c) $\bar{x} - 0.5R = 2.12 - 0.5 \times 0.12$
$= 2.06 > 2.0$ (L)

Since all criteria are satisfied, it is concluded that the lot conforms to the requirement of power input.

EXPLANATORY NOTE

This standard gives the method of sampling and criteria of conformity of the acceptance of pump besides laying down process control parameters to ensure product quality.

The criteria for conformity is based on assumption that the various quality characteristics follow normal or approximately normal distribution.

The acceptable quality level of sampling plans varies from 2.5 to 4 percent.